

Ordinal Deep Learning for Facial Age Estimation

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ABSTRACT: An ordinal deep learning approach for facial age estimation is proposed. Unlike conventional hand-crafted feature based methods that require prior and expert knowledge, we propose an ordinal deep feature learning (ODFL) method to learn feature descriptors for face representation directly from raw pixels. Motivated by the fact that age labels are chronologically correlated and age estimation is an ordinal learning problem, our proposed ODFL enforces two criterions on the descriptors which are learned at the top of the deep networks: 1. The topology-preserving ordinal relation is employed to exploit the order information in the learned feature space, and 2. The age difference cost information is leveraged to dynamically measure face pairs with different age value gaps. However both the procedures of feature extraction and age estimation are learned independently in ODFL, which may lead to sub-optimal problem. To address this, we further propose an end-to-end ordinal deep learning (ODL) framework, where the complementary information of both procedures is exploited to reinforce our model. Extensive experimental results on five face aging datasets show that both our ODFL and ODL achieve superior performance in comparisons with most state-of-the-art methods.

KEYWORDS: Ordinal Deep Learning (ODL), Ordinal Deep Feature Learning (ODFL) Facial age estimation, deep learning, feature learning, ordinal embedding.

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Digital Processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are Pre-processing, enhancement and display, information extraction.

II. BASIC OF FACIAL AGE ESTIMATION

Numerous facial age estimation methods have been proposed over the past two decades. However, these methods usually employ hand-crafted features such as the holistic subspace feature local binary pattern (LBP) and the bio-inspired feature (BIF) for face representation, which require strong expert knowledge by hand. To address this, several attempts have been made to learn discriminative face descriptors by using advanced feature learning approaches. These methods aim to seek simple feature filters, so that they are not powerful enough to exploit the nonlinear relationship of face samples in such cases that facial images are exposed to large variances of diverse facial expressions and cluttered background.

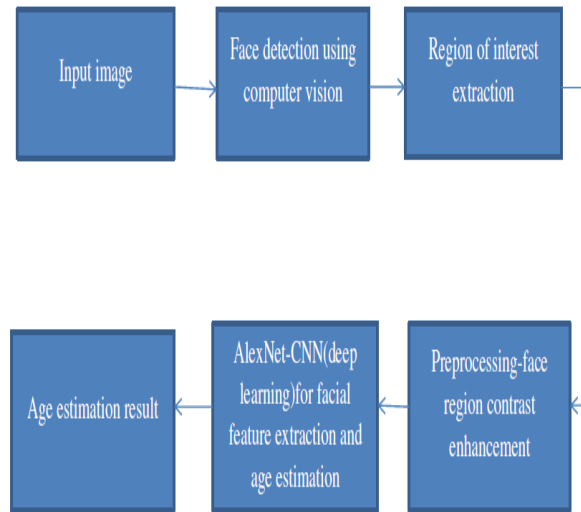


Fig1. Block diagram of Facial Age Estimation

The proposed system has following steps,

1. First collecting of database from public database. That database containing images of different age category people.
2. Second, computer vision face detection model is proposed for detecting the face region in testing image. After that, cropping of detected face region is proposing for further process.
3. Third, Preprocessing is an important step in the image analysis process. The task of preprocessing is to enhance the image quality. By doing so, we can make better decisions. In order to, we propose adaptive histogram equalization for image enhancement.
4. Finally, deep learning model is used for estimate the age. Deep learning performs the both facial features extraction and age classification process.

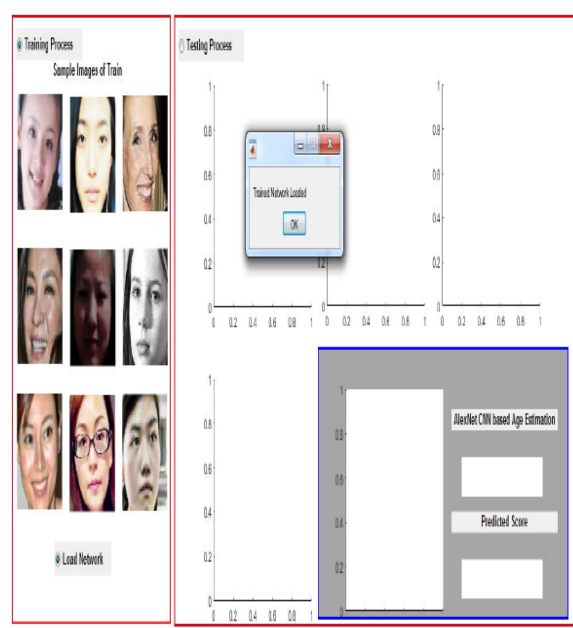


Fig 2. Facial Age Estimation Based on Deep Learning

III. MODULES

Age Estimation done by following modules,

1. Image Acquisition
2. Face Detection
3. Preprocessing
4. Age Estimation

MODULE DESCRIPTION:

1. Image Acquisition:

In this module, images are acquired from public database.

2. Face Detection:

After the image acquisition, face detection is implemented to test image. The computer vision face detection tool is used for detect the face in image. After that detected face was cropped for next process. This is called region of interest (ROI's) extraction process.

3. Preprocessing:

The third stage of age estimation is contrast normalization. After that image resizing process (227*227) is implemented. In that, image contrast is normalized by adaptive histogram equalization (AHE) process.

4. Age Estimation:

After the face detection & preprocessing, facial feature extraction and age estimation is implemented using AlexNet CNN. Proposed method shows how to use transfer learning to retrain Alex Net, a pretrained convolutional neural network, to recognize a new set of images.

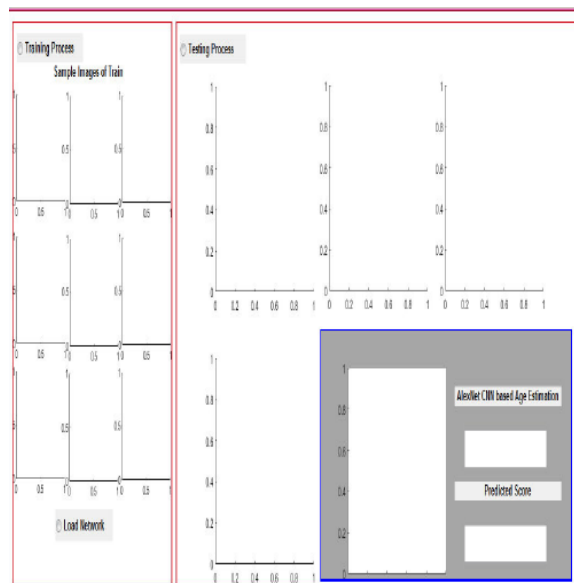


Fig 3. Facial Age Estimation Based on Deep Learning

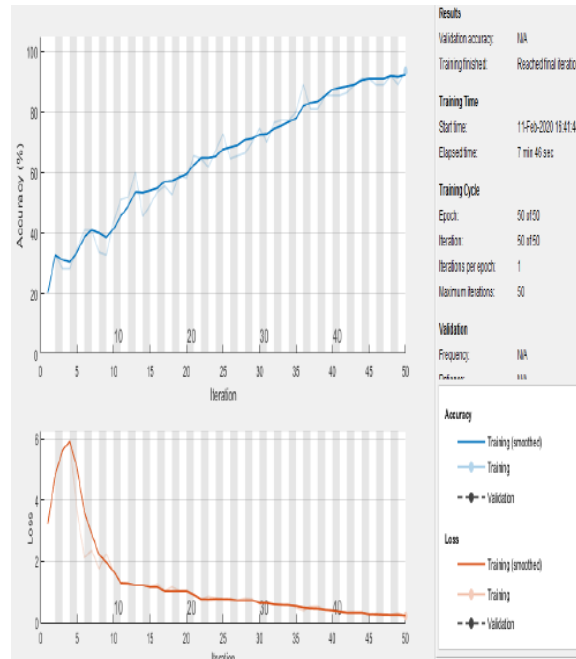


Fig 4. Training process of Facial Age Estimation

The proposed system achieves the best performance than the state-of-the-art approaches. The results show that our ODFL achieves exploiting the complementary information for both quadruplet and triplet-based comparisons of face samples, which simultaneously improves the age prediction performance.

IV. CONCLUSION

Furthermore, we have proposed an end-to-end deep learning framework ODL, so that both procedures of extracting facial features and predicting age values are jointly optimized in a unified deep learning framework. Experimental results on five face aging datasets show the effectiveness of the proposed methods. Since our method is complementary to any deep networks, we believe that our model can achieve a big improvement after introducing a large scale of face aging data, as well as auxiliary facial attributes. It is desirable to address facial age estimation with the feed-back deep networks to further exploit with the complementary information for the personalized aging pattern. Moreover, how to exploit the order information for face aging problem which might help to promote performance of the age-invariant face recognition is an interesting work in the future.



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